

History of the Atlantic Pearl-Oyster, *Pinctata imbricata*, Industry in Venezuela and Colombia, with Biological and Ecological Observations

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Introduction

Around the year 1500, discoveries by Spanish explorers of sources of pearls, gold, and spices in the New World were a powerful stimulus for Spain to expand

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ABSTRACT—In the 1500's, the waters of Venezuela and to a lesser extent Colombia produced more natural pearls than any place ever produced in the world in any succeeding century. Atlantic pearl-oysters, *Pinctata imbricata* Röding 1798, were harvested almost entirely by divers. The pearls from them were exported to Spain and other European countries. By the end of the 1500's, the pearl oysters had become much scarcer, and little harvesting took place during the 1600's and 1700's. Harvesting began to accelerate slowly in the mid 1800's and has since continued but at a much lower rate than in the 1500's. The harvesting methods have been hand collecting by divers until the early 1960's, dredging from the 1500's to the present, and hardhat diving from 1912 to the early 1960's. Since the mid 1900's, Japan and other countries of the western Pacific rim have inundated world markets with cultured pearls that are of better quality and are cheaper than natural pearls, and the marketing of natural pearls has nearly ended. The pearl oyster fishery in Colombia ended in the 1940's, but it has continued in Venezuela with the fishermen selling the meats to support themselves; previously most meats had been discarded. A small quantity of pearls is now taken, and the fishery, which comprised about 3,000 fishermen in 1947, comprised about 300 in 2002.

into the Americas. Samples of these resources, which Christopher Columbus and later crews brought back to Spain, so aroused public enthusiasm in Spain that navigators, explorers, and adventurers began to organize expeditions to seek the treasures of lands beyond the "Western Ocean." Columbus first saw the pearls in the Gulf of Paria, Venezuela, on his third voyage, where local Indians had brought them from the Caribbean coast of Venezuela located to the northwest (Mosk, 1934, quoted by Galtsoff, 1950b; Morison, 1942; Hanson, 1967; Wagner, 1992).

The Spanish subsequently organized harvesting programs for pearl oysters in Venezuela and Colombia and began to ship huge quantities of pearls to Spain and other European countries for ladies adornment. The first Spanish town in the New World was established in 1528 on the Venezuelan island of Cubagua to serve as a center for harvesting pearl oysters and collecting pearls. The pearls from Venezuela, whose northeast shores became known as the "Pearl Coast," were relatively small, weighing 2–5 carats, but they were harvested in the largest quantities of any location in the New World. Within a decade or two following the discovery of the Venezuelan pearls, the Spanish found pearls and developed programs to harvest them on beds around islands off the Pacific Coast of Panama (Galtsoff, 1950a; MacKenzie, 1999) and in the Gulf of California, Mexico (Townsend, 1892; Kunz and Stevenson, 1908). They also searched for pearls in what is now the United States, but found none in its marine environments (Kunz and Stevenson, 1908).

By the late 1500's, the pearl oysters in Venezuela and Colombia had become much scarcer as a result of intensive fishing by hundreds of divers (Landman et al., 2001). Documentations of the pearl production may be the first records of resource declines in any of the world's marine fisheries that were brought about by intensive harvesting stimulated by strong market demand. In this case, large beds of natural pearl oysters that had been scarcely harvested beforehand were harvested intensely, albeit by primitive hand methods, and the beds were slowly depleted.

In 1948, Paul S. Galtsoff of the U.S. Bureau of Commercial Fisheries (now the National Marine Fisheries Service, NOAA) spent 2 months on Margarita Island, Venezuela, at the request of the Venezuelan Government which wanted him to recommend measures for managing its pearl oyster industry. This followed his similar stay in Panama for the same purpose (Galtsoff, 1950a). Galtsoff (1950b) reviewed the history of the Venezuelan pearl oyster industry, made observations and recommended research and management strategies, and later described them in that paper. Nothing has appeared in the international literature regarding this fishery since his paper was published. The senior author visited Margarita Island from 20 to 31 January 2002 to determine the history of this fishery industry between 1948 and 2002, collect additional earlier historical material, and photograph pertinent scenes. L. Troccoli and L. B. León S. have had long associations with fisheries in the Margarita Island–Cubagua Island–Coche Island region and contributed to this

paper printed and verbal information about the fishery, the biology and ecology of the pearl oysters, and additional photographs.

The Pearl Oyster in the Caribbean Sea

The species of pearl oyster in the Caribbean Sea is the Atlantic pearl-oyster, *Pinctada imbricata* Röding 1798. It ranges beyond the Caribbean Sea to as far north as North Carolina (Ruppert and Fox, 1998) and south to Brazil (Abbott, 1974). The main fisheries for it have been off the coasts of Venezuela and northeastern Colombia. In Venezuela, the harvesting has been centered on beds near the clustered islands of Margarita Island, Cubagua Island, and Coche Island, 12–18 km off its northern coast (Fig. 1). Colombia's pearl oyster fishery was 1,000 km to the west on beds off the Guajira Peninsula close to the Venezuelan border. Bohlander (1992) reported that the explorer Alonso de Ojeda, in about 1500, observed people fishing for pearl oysters in what is now Lake Maracaibo, Colombia, but pearl oyster harvests there have not been described elsewhere to our knowledge.

The shells (valves) of pearl oysters are somewhat similar to some other oyster species. Its left valve is more concave than the right, and it has a byssal opening, a structure not universal in oysters (Fig. 2). The valves, which rarely exceed 7 cm in length, have three sections: a periostracum, a prismatic layer, and a nacre layer (León et al., 1987). The color of the outer surface of the valves varies from white to bronze and occasionally to black (Cervigon, 1998). Owing to its relatively small size and because its valves are thin, Atlantic pearl-oysters have not been used in the mother-of-pearl trade, which deals in ornaments, knife handles, and buttons from the larger pearl oyster shells harvested off the west coast of North America and in Asia. By 1900, thousands of tons of the pearl oyster shells lay in heaps along the Venezuelan coasts and in smaller quantities on the Colombian coast, where they had been left for centuries by oyster shuckers (Kunz and Stevenson, 1908).



Figure 1.— Shaded area to right of Cubagua Island is the location of Las Cabeceras pearl oyster bed, the principal commercial bed in recent years. The Venezuelan mainland is in the foreground.

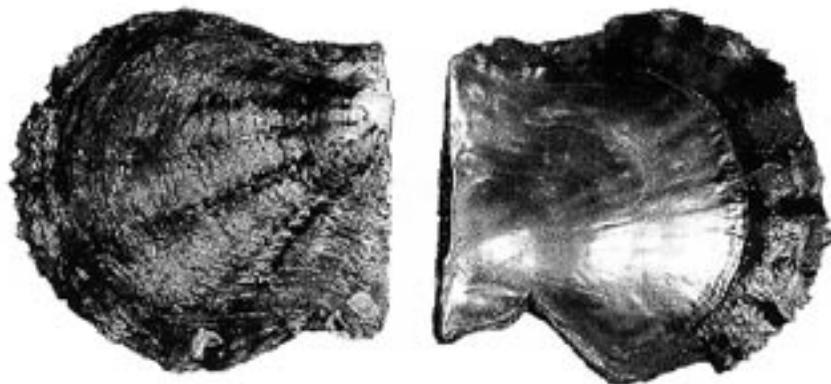


Figure 2.—The outer and inner surfaces of the valves of a Atlantic pearl-oyster, *Pinctada imbricata*.

Pearl Oyster Biology

At the time of Galtsoff's (1950b) survey in 1948, knowledge of the spawning, setting, and growth of the pearl oyster was scarce, but it was known that

its larvae will set on hard objects with a clean surface, and growth of young pearl oysters is rapid. Some biological information relating to reproduction has since been gathered.

The Atlantic pearl-oyster is a protandric hermaphrodite. The small mature pearl oysters are males; the large pearl oysters are females. Their gonad surrounds their digestive diverticulum. Sperm and eggs are spawned into the water where fertilization takes place. The unfertilized eggs are 47–50 μ in diameter; the sperm are 60 μ long. In a laboratory study, the larvae resulting after fertilization took 20–25 days to grow to settlement size: 215 μ (Ruffini, 1984) (Fig. 3, 4). Occurring in the tropics at lat. 11°–12°N, this pearl oyster has a relatively long spawning season as do many tropical species. Reproduction takes place throughout the year, as shown by juveniles less than 5 mm long being present during all months, but setting is heaviest from June into November and December when water temperatures are highest. Water temperatures rise from about 24°–25°C to 26°–28.5°C during May to November, when the oysters spawn, and their condition index, determined by the volumetric method, drops from about 65–70% to 40–50%. This index is lowest during October and November. The Las Cabeceras bed (Fig. 5), the largest remaining bed, had the highest recruitment of pearl oyster spat of the beds surveyed. The oysters grow from settlement size to about 7 cm within 14 months (León et al., 1987).

Ecology of Pearl Oyster Beds

The Atlantic pearl oyster inhabits clear waters (Cervigon, 1998). It does not occur where changes in temperature, salinity, and oxygen are large or on muddy bottoms (León et al., 1987). Its ready-to-set larvae attach with a byssus to hard substrates including other pearl oysters, rocks, dead coral and octocorals, other molluscan shells, and barnacles (Table 1). The oysters retain this attachment with several byssal threads throughout their lives unless, while seed, they are torn free by fishermen. Empty pearl oyster shells apparently do not accumulate beneath live pearl oysters as empty shells do in beds of the eastern oyster, *Crassostrea virginica*, in Canada and the United States. As an example, the oysters on the centuries-old Las Cabeceras pearl oyster bed near Cubagua Island rest on a base

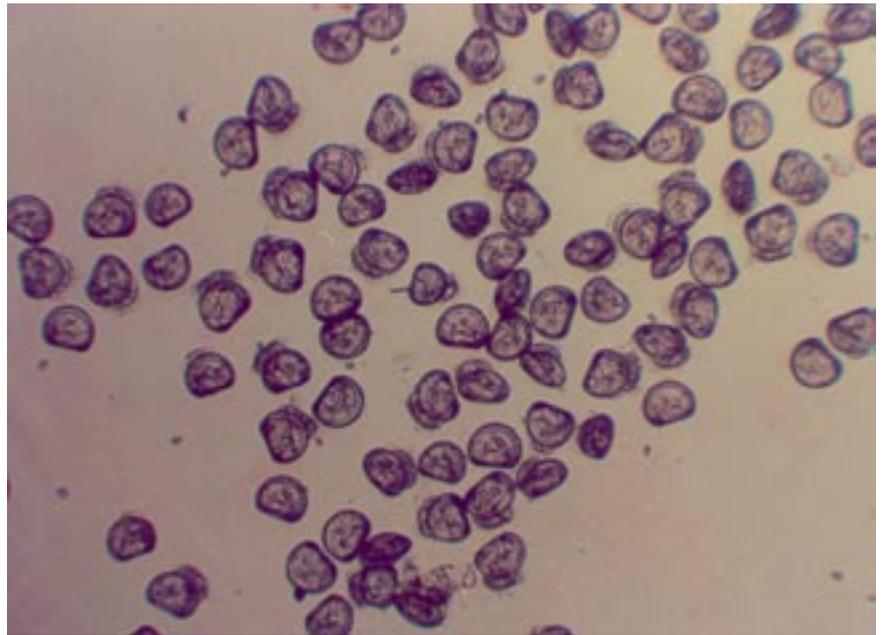


Figure 3.—Straight-hinge larvae of the Atlantic pearl-oyster, *Pinctata imbricata*.

Table 1.—Types of bottom on which Atlantic pearl-oysters, *Pinctata imbricata*, grow off the coast of Guajira in Colombia (Borrero et al., 1996).

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|----------------------------------------------------------------------------------------------------------------|
| 1. Hard conglomerates or nodules in 1–3.5 m of water, |
| 2. Plain bottom of sand mixed with hard substrate in 8–12 m of water, |
| 3. Octocorals, gastropods, hard corals in agitated water in 6–12 m of water, |
| 4. Dispersed octocorals and algae on sand bottom in calm water in 4–8 m of water (not many pearl oysters), and |
| 5. Dense beds of octocorals in 3–9 m of water (not many pearl oysters). |



Figure 4.—Umbo larva of the Atlantic pearl-oyster, *Pinctata imbricata*.

of sand rather than a deep base of empty pearl oyster shells. In some locations, eastern oysters rest on bases of shells at least 7 m deep.

The relatively shallow regions (down to at least 20 m) surrounding the islands of Margarita, Cubagua, and Coche and those off the peninsula of La Guajira and in Chengue Bay, Colombia, become enriched with nutrients (mainly nitrates, silicates, and phosphates) from December through February each year, when extra strong easterly winds cause upwelling that brings waters from the nearby ocean depths into the shallows (Fig. 6). Water temperatures that usually are about 26°–28°C in summer become 2–3°C cooler and the salinity increases by about 2‰ to nearly 36‰. The nutrients stimu-

late a large increase in phytoplankton that feeds fish (mainly sardines, *Sardinella aurita*) and mollusks (i.e. pearl oysters and mussels, *Perna perna*) that increase sharply in overall size but especially the sizes of their gonads throughout this period, in advance of spawning (León et al., 1987; Cervigon, 1998; Gaspar, 1999; Urban, 2000a). The fisheries for these resources benefit enormously (León and Millán Q., 1996).

The taxonomic list of mollusks associated with *P. imbricata* on and near the Las Cabeceras bed includes 89 species: 48 gastropods, 34 bivalves, 6 cephalopods, and 1 chiton (Fig. 7) (León, unpubl. data).

In 1948, northeastern Venezuela had about 76 identified pearl oyster beds, nearly all of which were too small for worthwhile harvesting. The beds were located in the same areas as they had been historically, i.e. between Margarita Island and the Peninsula de Araya on the

Venezuelan mainland, in depths from 4 to 20 m; several more beds were located off the north and northeastern shores of Margarita Island. The largest beds were at least 2.5 km across, and the most productive was the Las Cabeceras bed just east of Cubagua Island (Galtsoff, 1950b).

In Colombia, pearl oysters were harvested from a bottom area that extended for 150 km just off the coast of Guajira. In 1994, a survey of the abandoned beds found concentrations of live pearl oysters that ranged from 0.05 to 2.77 oysters/m². Pearl oysters larger than 5 cm (marketable size) ranged from 25% to 49% of the total oysters. In one location, of the 493 pearl oysters that were opened, 17 had pearls (3.4%), most of which were around 2.5 mm in diameter, while in another location 279 pearl oysters had 12 pearls (4.3%) about 1.5 mm in diameter. The pearls lacked the shape and luster required of good quality gems and were too scarce for commercial harvesting. Settlement densities of pearl oyster spat (juveniles), nonetheless, appeared to be sufficient to support a program of pearl culture which would include collecting spat on shells and other materials (Borrero et al., 1996).

Urban (2000b) observed aspects of *P. imbricata* reproduction in Chengue Bay, Venezuela, in 1997 and 1998. Chengue Bay is located on the north coast of Venezuela 150 km west of the Guajira pearl oyster area described by Borrero et al. (1996) and 14 km north northeast of the city of Santa Marta. Some natural stocks of *P. imbricata* are present in this bay. Urban (2000b) found the highest abundances of their larvae in November 1997 (1 collection: 0.8 larvae/m³) and in January through March, 1998 (1 collection each month: 1.0 larva/m³, average), but some larvae were collected in nearly every month. Spat were collected in bags of plastic mesh (onion bags) squeezed into net bags.

Urban (2000b) also identified two principal groups of predators consuming the pearl oyster spat: gastropods and crabs. The gastropods consisted of three species of the genus *Cymatium*, and the crabs belonged to three families: Portunidae, Xanthidae, and Majidae. The spiny lobster, *Panulis argus*, also preyed on the spat, but its abundance was lower than the other species. The surviving oysters grew to market size within 12 months. Urban (2000a,b) concurred with Borrero et al. (1996) that the Atlantic pearl-oyster produced sufficiently large numbers of spat to support a culture program, but he

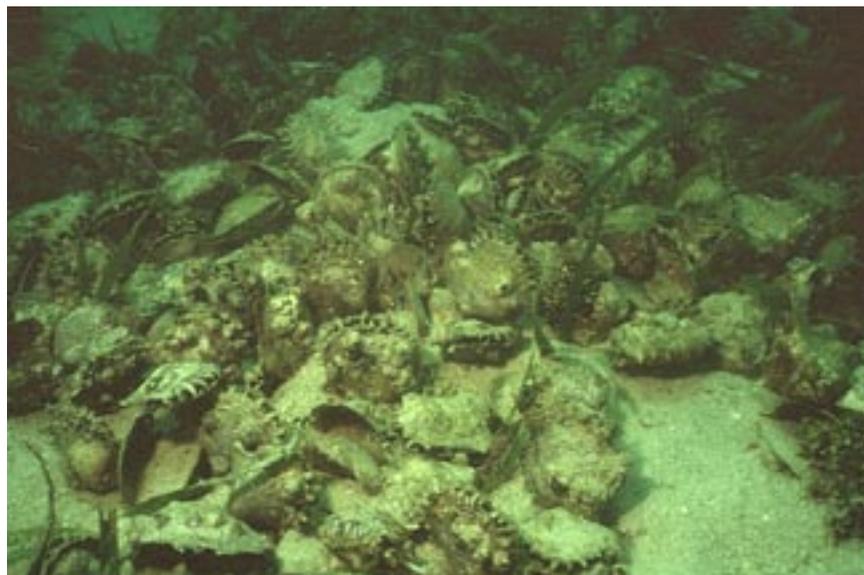


Figure 5.—Pearl oysters on Las Cabeceras bed off Cubagua Island, Venezuela.

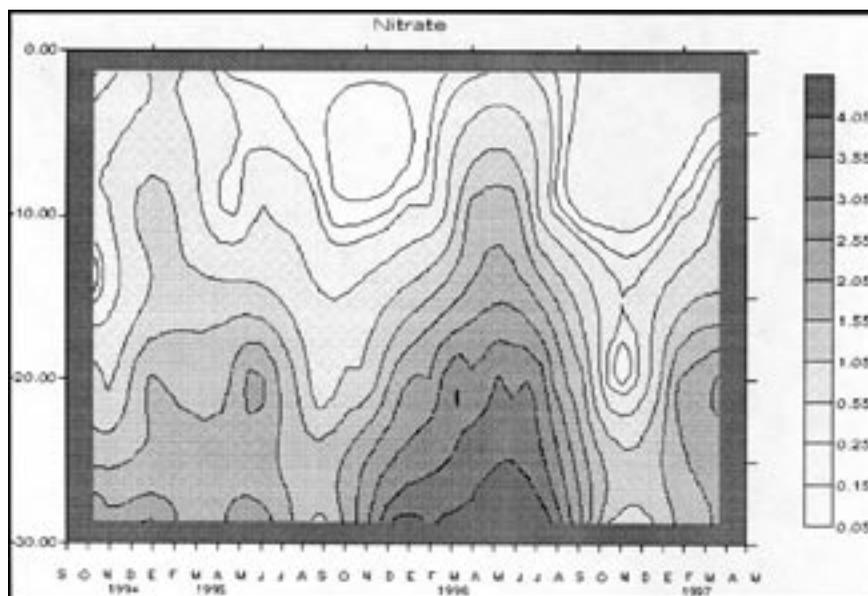


Figure 6.—Concentration (micromoles/liter) of nitrate in water at a sampling station off the south coast of Margarita Island, 1994 to 1997. Note the highest concentrations were during the months from February to August, the months of upwelling caused by consistently strong winds (from León and Millán Q., 1996).

expressed uncertainty about it because he observed a high mortality in the spat.

Historical Methods of Harvesting Pearl Oysters

Through history, pearl oysters have been harvested by diving and dredging. Before 1500, the natives harvested pearl oysters by diving without gear, and this method continued to the early 1960's. Hardhat diving lasted from about 1912 to 1963. Dredging, which began in a rudimentary way in the 1500's, was intermittent over time, but done regularly throughout the 1900's and in 2000 and 2001.

Pearl Diving

Descriptions of divers gathering pearl oysters are available from a few sources. Venezuelan Indians harvested oysters by diving to the bottom with a basket containing a weight and collecting them by hand. They dove without clothes, masks, or flippers. After 1–1.5 minutes on the bottom, they returned to the surface to breathe and deliver the pearl oysters they collected in the basket. They ate the oysters and kept the pearls found in some of them (Trevesan 1502 or 1504, quoted from Wilson, 1941).

Pearl oyster harvesting by enslaved Indians in the early 1500's was described by Oviedo y Valdéz (1535, quoted by Galtsoff, 1950b). From four to seven divers in each canoe paddled under the supervision of their master from Cubagua Island to places where the oysters were most abundant and anchored the boat. The divers each weighted themselves with a rock. Use of a rock enabled them to harvest longer, because they descended to the bottom more quickly. By thus expending less energy, they could hold their breath longer. The rock apparently was on a line and was retrieved by a tender in the canoe after the diver reached the bottom, though this can only be assumed as no description is available. Divers gathered as many oysters as they could in a bag they carried before having to return to the surface for air. The divers were forced to make many daily trips to the bottom.

A more recent and true story, famous on Margarita Island, relates to a diver, named Domingo, in about 1912. Do-



Figure 7.—Live animals and shells dredged from Las Cabeceras pearl oyster bed, February 1992.

mingo was harvesting pearl oysters on the Las Cabeceras bed off Cubagua Island when a sting ray, *Rajiformes*, stung his leg. He was able to rise to the surface and other divers brought him ashore. His poisoned leg swelled. A doctor told him the leg would have to be amputated or he likely would die. He did not want to lose his leg because he would not be able to work any more and his family would starve. Domingo and his wife prayed to their patron saint, Virgen del Valle, asking her to save his leg. They promised to give her a fine pearl if she did. His leg soon recovered, and, during the first day he returned to diving, he saw an extra large oyster on the bottom. He brought it to the surface, and, upon opening it, saw a large pearl. It was 17 mm long and was shaped like a leg except for 2 projections at one end (Fig. 8). His friends urged him to sell it to obtain a large amount of money. He was offered 100,000 Bolívares, which he refused saying, “No, the pearl belongs to the saint, and I will give it to her.” He did and the pearl now rests on the crown of a statue of the saint in a church museum on Margarita Island (Cornieles¹). The

¹ Cornieles, Louis. First author's guide and translator. Porlamar, Isla Margarita, Venezuela. Personal commun., 2002.

pearl's unusual shape added substantially to local interest in the story.

In the 1930's and 1940's, divers went to the beds in small sailboats and sometimes were assisted by one or two tenders. Working without mask or flippers in 5–9 m of water, they swam to the bottom quickly and filled their bags with as many oysters as they could before returning to the surface to breathe. Tenders in the boats retrieved their bags of oysters from the bottom using a rope and emptied them. The tenders picked out the large oysters and tossed any remaining material overboard (Galtsoff, 1950b).

Dredging

Galtsoff (1950b) described the pearl oyster dredge as a light, cast iron frame with a scraping blade to which a net bag is attached. The bag was maintained slightly above the bottom by 4–5 wooden sticks attached to its bottom to prevent it from being torn by rocks and corals. According to the present law (Art. 17, Chapter III, Ley de Pesca de Perlas, 1944), the size of a dredge cannot exceed 100 cm wide by 80 cm high. The dredges weigh 9–14 kg. The dredging boats that operated until the 1950's were about 6 m long and were propelled by sail (Fig. 9, 10). They had a crew of five men, four of whom

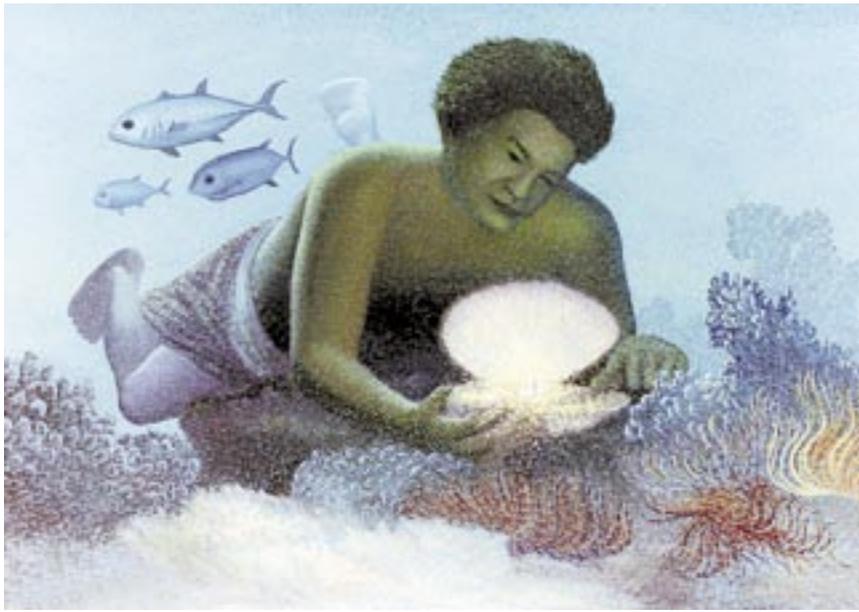


Figure 8.—Depiction of a diver finding a famous pearl, 17 mm long and shaped like a leg, destined as a gift to the saint of his church, whom he believed saved his poisoned leg; he actually opened the oyster in his boat. This painting and the pearl are on display in a church museum on Margarita Island.

tossed out and pulled up the two dredges and also culled and packed the oysters, while the fifth man handled the sail and rudder. The dredging boats harvested mostly on sand bottoms.

In 2002, observations were made on a boat dredging for oysters on the Las Cabeceras bed. The 6 m boat was propelled by an outboard motor and had a crew of three, all barefoot. The crew was allowed to tow one dredge (it had a 20 mm diameter towing rope) and could not use mechanical means to retrieve it. The crew located good harvesting locations by sighting and lining up prominent structures and points on land. They made several tows. Each time, they towed the dredge for 10–15 min, and two men pulled it up by hand for emptying while the third man handled the engine. The dredge usually had 1–1.5 bu of material in each lift: molluscan shells, pearl oyster “keepers” that ranged from 5 to 6 cm long, undersized pearl oysters attached by their byssuses to oysters and



Figure 9.—A sailing vessel used for dredging pearl oysters, pre 1950’s.

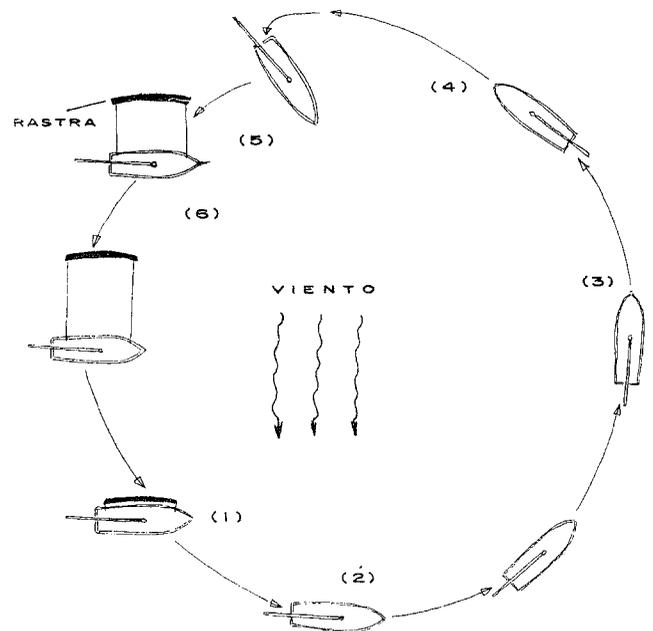


Figure 10.—The pattern sail boats traveled when dredging oysters. A boat towed dredges in locations 5 and 6, retrieved them at location 1, and then in locations 1–5 sailed back to dredging location (from Mendosa-Arocha, 1963). Note rastra means dredge and viento means wind.

shells, sand dollars (as large as 15 cm in diameter), mussels, at least four species of starfish, barnacles, bryozoans, octopi that were commonly 10 cm long, sea urchins, crabs, and gastropods. The crew dumped the material onto the floor of the boat, tossed the dredge over again, and then searched through the material for keeper pearl oysters. They pulled them from the undersized oysters and mussels, tossed them into a shallow plastic tub, which when full they emptied into sacks. The remaining material which comprised at least 95% of the original volume was tossed overboard. At the end of the fishing day, the boat returned to the beach where the pearl oysters were cooked and shucked. In the 1990's, oyster dredging boats had crews of four to five men (Fig. 11, 12).

Hardhat Diving

The hardhat divers, who harvested pearl oysters from 1912 to 1963, ranged from 18 to 70 years old. They were taught how to use the gear and harvest oysters by relatives from generation to generation, but the training took only one day. The worst problem for a diver was leg cramps due to the cool water, and some older divers had heart attacks. A man needed an annual certificate of health, especially relating to his heart, to obtain permission from government officials to use the hardhat gear (Hernandez Salazar²).

² Hernandez Salazar, Leon Ramon. 82-year-old retired hardhat diver, Isla Margarita, Venezuela. January, 2002.

In the mid 1940's, the boats used in hardhat diving, all under sail, were each equipped with a hand-operated, two-cylinder piston air pump, a hardhat suit and helmet, and about 175 m of rubber hose and signal line. They had 7-man crews: the diver, two men who worked together turning the wheels that operated the pump driving air down to him, a man who relieved the pumpers, two linemen, and a cook (Fig. 13, 14). The original suits were made of rubber, but nylon was used after World War II. Imported from Europe and the United States, the suits were similar to jumpsuits with rubber at the waist as a belt. The first helmets had lead skirts that laid over the diver's chest and back. Together, they weighed 25 kg. The helmet and heavy lead boots he wore on his feet maintained him steadily on the bottom (Hernandez Salazar²).

The hardhat divers worked every day that had light to moderate winds. They harvested mostly on bottoms consisting of mixed corals, shells, and rocks as they had the better pearl oysters than bottoms consisting of sand. Upon reaching a harvesting location, the crew anchored the boat and helped the diver into his suit. He first slipped on wool pants, a long sleeve shirt, socks, and then the suit. Next he put on knee pads and leather caps over the ends of his fingers to protect them from cuts and abrasions, and finally he put on the helmet and boots (Fig. 15). The suit lasted about 3 months unless it was torn on coral sooner.

When the diver was ready, the air hose and signal line from the boat to the diver

were let out 46–50 m, with the extra hose and line remaining on the boat, and then the diver climbed onto a ladder and the crew lowered him to the bottom by the signal line and air hose. The diver jerked the line twice to signal he had reached bottom. He remained in the water harvesting for 2–3 hours without coming up for rest, food, or water. The helmet had a regulator valve that the diver could close to inflate his suit when he wanted to ascend to the surface (Hernandez Salazar²).

While harvesting, the diver could see objects at least 30 m away through the clear water including other divers; the divers had a personal code not to enter one another's harvesting areas. Harvesting pearl oysters was like picking fruit. The diver got down on one knee, picked up clusters of oysters, removed the "flowers" (seed), and put the large oysters in piles. When he yanked on the signal rope, the cook and standby man lowered a metal net to the bottom. The diver filled it with oysters, signaled, and the crew pulled it up to the boat, removed any mussels and stray seed oysters, and put the oysters in sacks. Three netfuls filled a sack (Hernandez Salazar²), and a sack contained 875–1,350 oysters (Galtsoff, 1950b).

Some crews brought food along with them, while others caught fish with hooks and lines while the diver speared some fish and gathered some mussels to eat. A boat brought the pearl oyster crews fresh water to drink. Each day, a diver spent 5–6 h on the bottom. The daily harvest



Figure 11.—Tossing out a dredge to harvest pearl oysters from Las Cabeceras bed, winter 1990's.



Figure 12.—Boarding a dredgeful of pearl oysters and other material from Las Cabeceras bed, winter 1990's.



Figure 13.—Crew pumping air to hardhat diver harvesting pearl oysters from the bottom below, probably 1940's (from Cervigon, 1998).

was 15–20 sacks of oysters/boat; the least a boat harvested was about 6 sacks/day. During a season, a diving crew harvested about 1,000 carats of pearls. Between harvesting seasons, the divers and crews caught fish to sell or found other odd jobs to earn money (Hernandez Salazar²).

The Discovery of Pearls in the New World

This sketch of the discovery of pearls in the Caribbean Sea is pieced together from several disparate, brief writings from the 1500's and later summaries of them in various publications which are cited in this section. The existence of pearls in the New World became known in Spain after Admiral Christopher Columbus' third voyage. On his first voyage, in 1492, he landed in the Bahamas and then explored Cuba and Hispanola (Haiti and the Dominican Republic). On his third voyage, in 1498, Columbus reached the South American mainland near what is now the Gulf of Paria near the Orinoco River in Venezuela and saw the natives

Figure 15.—Crew assisting hardhat diver prepare to enter water and harvest pearl oysters, probably 1940's (from Cervigon, 1998).

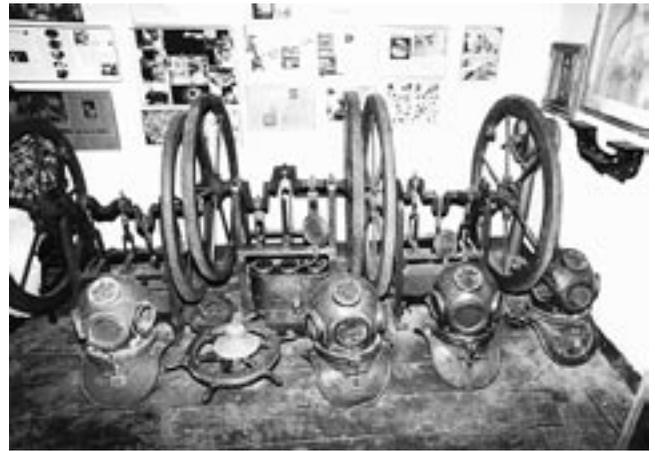


Figure 14.—A display in Porlamar museum of hardhats and air pumps used by fishermen who harvested pearl oysters from 1912 to early 1960's.



with pearls and gold. Women boarded his ship wearing necklaces of seeds interspersed with fine pearls. They said the pearls came from areas off the coast of the Peninsula de Araya in the Caribbean Sea as far as 100 km away. Columbus then sailed past Margarita Island, Cubagua Island, and Coche Island and went back to Hispanola, missing the sources of the pearls on those islands. In 1499,

Alonso de Hojeda was the first Spaniard to discover the pearl resources of the three islands (Galtsoff, 1950b; Morison, 1942, 1963; Cervigon, 1998; Landman et al., 2001).

In 1499, Columbus sent two of his ships back to Spain with some pearls. Later in 1499, Peralonso Niño, former pilot of Columbus' ships *Santa Maria* and *Niña*, captained a ship that sailed

from Spain to further explore what was to become the “Pearl Coast,” i.e. collectively, Margarita Island, Cubagua Island, Coche Island, and the Peninsula de Araya. Niño traded bells, pins, bracelets, strings of crystal, rings, and other objects with the natives for their pearls, and in 1500 returned to Spain with between 11 and 44 kg of pearls. This trip by Niño was the first to the new continent that was economically successful. Trading in pearls soon expanded to become the business of directed pearl fishing and permanent settlements near the pearl oyster grounds were established (Galtsoff, 1950b; Morison, 1942, 1963; Cervigon, 1998; Landman et al., 2001).

1500's

The Founding of Nueva Cadiz: First Spanish Town

In 1509, King Ferdinand II of Spain and his representatives directed that a permanent settlement be established on Cubagua Island from where crews in canoes would go to the beds and harvest pearl oysters, and it would also serve as a collection center. From there, the pearls then would be sent to the ports of Santo Domingo, San Juan, and Havana, and then on to Spain (Fig. 16).

The Spaniards forced the Indians living on the islands into slavery, and made the men paddle canoes to the beds and dive for the pearl oysters. Whenever more divers were needed, the Spaniards brought slaves from the Venezuelan mainland and the Bahamas. The Taino Indians of the Bahamas were considered good harvesters because they had experience diving for queen conchs, *Strombus gigas*, one of their staple foods. The Spaniards paid as much as 150 ducats for each slave. In 1512, the first Spanish settlement, consisting of a group of huts made of palm trees, was established on Cubagua Island. In 1520, the native Indians on the Venezuelan mainland, located about 15 km south of Cubagua, rebelled in retaliation for raids by Spanish crews. This forced a temporary abandonment of the Cubaguan settlement by the 300 Spanish settlers because they were dependent on supplies, mainly food, from



Figure 16.—The locations of the Guajira Peninsula, Colombia, and Margarita Island, Venezuela, where pearl oysters were harvested, and Santo Domingo and San Juan where pearls were sent before being sailed to Spain.

the mainland (Galtsoff, 1950b; Sauer, 1966; Cervigon, 1998).

In 1528, the settlement was restored with about 1,000 Spaniards. This was the first Spanish town founded in South America and the New World and was named Nueva Cadiz. Between 1530 and 1535, about 1,500 people lived in the town, and it enjoyed its greatest prosperity. The officials of Nueva Cadiz sorted the pearls into different grades, each being given a value in gold. The shades of pearls in the various grades could be white, yellow, or pink. Individual buyers selected the colors they liked best; any price differences between the different colors are unknown. They shipped an average of 800,000 pesos worth of pearls to Europe annually (Wagner, 1992; Cervigon, 1998).

From 1510 to 1537, the pearl harvesting spread. Initially concentrated on the oyster beds near Cubagua Island, the harvesting later expanded to other beds off

the south coast of Peninsula de Macanao on Margarita Island, off Coche Island, off the coast of the Peninsula de Araya on the Venezuelan mainland, and eventually off the coast of the Guajira Peninsula in Colombia (Landman et al., 2001). The Spanish government then issued special rules to maintain the fishery and the supply of pearls. Among them were: 1) Ranches (groups of huts for sleeping and for storing oysters and pearls) would be established near the pearl oyster beds, 2) each ranch would have a large box with two locks in which to safeguard the pearls, and 3) the ranches would obtain canoes, each armed and manned by no less than 12 slaves (Cervigon, 1998).

In 1541, Nueva Cadiz was destroyed by a hurricane, and the site was abandoned by 1545, mainly because the pearl oysters on nearby beds had become much scarcer owing to heavy harvesting. After that, Cubagua Island was gradually deserted (Wagner, 1992).

In about the year 1570, the Venezuelan State of Nueva Esparta, comprising Margarita Island, Cubagua Island, and Coche Island, was founded. Its official seal depicts a string of pearls and a canoe paddled by divers (Fig. 17) (Cervigon, 1998).

Slaves Diving for Pearls: Indians and Blacks

In the 1500's, local Indians were the first enslaved to dive for pearl oysters for the Spanish; Black slaves later replaced them. Spanish government officials recognized the necessity of protecting the pearl resources and preserving the lives of Indian divers, so they issued several "humanitarian" measures. They sought to limit: 1) pearl fishing to the summer so the divers could always work in warm water, 2) the work of divers to 4 h a day at depths not exceeding 14.5 m, and 3) the performance of extra work. They decreed that the divers should receive good food, a pint of wine a day, clothing, and hammocks for sleeping. Hammocks kept sleepers away from crawling insects, especially ants, and



Figure 17.—The official seal of Nueva Esparta (comprising Margarita Island, Cubagua Island, and Coche Island), Venezuela, includes drawings of slaves paddling a canoe to or from the oyster beds and a string of pearls.

also lizards, scorpions, and snakes, and they are more comfortable to lie on than the damp, bare ground.

However, these well-meaning measures remained on paper and not the slightest attempt was made to enforce them, because the overseers had little concern for the well-being of their slaves (Galtsoff, 1950b). A monk, named Bartholomew de Las Casas, who apparently was present at the sites, reported that the divers were treated harshly. Even when out of breath and fatigued, they were permitted only short respites between dives. On land, they were given small amounts of food (types of food not known), and they had to sleep on the ground. The slaves consequently lived only about a year after they were forced to dive for the Spanish (Chambers, no date; MacEoin, 1965).

During the 1500's, slaves of African origin began to replace the Indian slaves in many parts of the New World (Haverstock, 1988). The first notice of this was in 1526 when 30 black slaves were brought to Cubagua Island. A Royal Decree of 25 June 1558 prohibited the future use of Indians in pearl fishing and said that only blacks could be used for this purpose (Galtsoff, 1950b).

Mendez-Arocha (1963) quotes Francisco de Los Cobol who described some aspects of the pearl oyster fishery operations and the collection of pearls by the black divers. The slave owners rented them out to work in the pearl fishery. The boats, some with as many as 24 black slaves, left the beaches in the morning under the direction of slave masters, paddled to a pearl oyster bed, and harvested oysters. After a sufficient oyster supply was gathered, they returned to Cubagua Island and ate some food that had been prepared by slaves left behind on the beach. They then sat around piles of the pearl oysters and opened them with knives under the watchful eyes of supervisors whose job was to prevent stealing. Each had a small bagful of pearls at the end of the day. But stealing did occur and the slaves gave the stolen pearls to their owner. As a reward, their owner gave them a big party along with some clothes and shoes every 15–30 days.

Pearls Valuable to Spain

During the first half of the 1500's, large quantities of Venezuelan pearls were shipped to Europe (Landman et al., 2001), and, in 1527, pearl production reached its maximum, 1,380 kg (Cervigon, 1998). From 1513 to 1530, at least 118 million pearls were harvested near Cubagua Island. Seville, Spain, became the center of the pearl market, where Garcilaso de la Vega wrote that pearls from Venezuela and Colombia were so abundant "they were sold in a heap in the India House ... just as if they were some kind of seed." Portraits of European royalty at the time revealed many pearls embroidered on their dresses and in their headdresses, necklaces, and earrings (Landman et al., 2001). More natural pearls were harvested in Venezuela and Colombia at this time than elsewhere over any comparable period of time before or since (Donkin, 1998).

The richness of the pearl grounds in the Margarita Island–Cubagua Island–Coche Island area can also be seen from the following records of Royal Treasury officials on Hispanola; the Royal Treasury kept 20% of the pearls harvested in Venezuelan waters. In the month of January, 1529, at least 12,000 ounces (340 kg) of pearls, or the equivalent of 17 million carats (1 metric carat = 200 mg), were taken from the pearl beds off Coche Island. In June 1533, a vessel that sailed from Spain carried at least 340 kg of pearls. In July 1534, another vessel received for shipment 2 boxes of pearls from Cubagua Island; one contained 1,600 ounces (45 kg) of "common" pearls, while another contained 8,000 ounces (227 kg) of small pearls. On January 24, 1553, the royal officials at Cubagua Island gave several boxes of pearls to one vessel. The Treasury's record books showed that the value of pearls averaged more than 800,000 pesos annually up to 1530 (Galtsoff, 1950b; Wagner, 1992).

In the 26-year period between 1576 and 1602, twenty-one ships carrying pearls sailed from Margarita Island. The most important pearl merchants were in Santo Domingo and San Juan, while the

most important European markets were Seville and also Amberes, Spain; Venice, Italy; and Lisbon, Portugal (Cervigon, 1998).

Pearl Oyster Bed Depletions

Oviedo y Valdés (1535; quoted by Galtsoff, 1950b) said the Spaniards were so aggressive in searching for pearls they were not content with just using divers to get them, so beginning in 1528 they used nets and crude dredges. They took such a quantity that the oysters were no longer found in abundance on the shallowest beds.

In the mid 1500's, many pearl fishermen and their divers moved from the partially-depleted Venezuelan beds to more recently discovered pearl oyster beds off the coast of the Guajira Peninsula in Colombia (Fig. 16, 18). The pearl oyster beds were a few hundred meters to several km off the coast, where the depths were from 3 to 10 m, and they covered a total area of about 68 km². Individual beds ranged in size from a few square meters to 17 km². Most were concentrated between the latitudes of the towns of Manaure and Arema. Little is known of the pearl oyster fishery in Colombia, except that it was considerably smaller than the one in Venezuela. Pearl oyster harvesting in Colombia went well at first, but the stocks declined fairly quickly, and thereafter it may have been intermittent. Middens containing shells of pearl oysters and other mollusks are scattered along this coast from Porpoktin to Cabo de la Vela (Borrero et al., 1996).

Most harvesting crews returned to Venezuela, where, in 1576, new pearl oyster beds were discovered around Cubagua Island and Coche Island. About 2,000 black slaves were imported to exploit them (Cervigon, 1998).

By the late 1500's, Venezuelan pearl production had fallen sharply, largely due to a scarcity of oysters. The harvesting rate had been rapid. Each boat sometimes collected as many as 35,000 oysters in 2–3 weeks (Galtsoff, 1950b). Other reasons for the lower pearl production were: 1) the local Indians became deadly foes, 2) many Spaniards left Venezuela for the rich pearl oyster grounds in Panama and the Gulf of

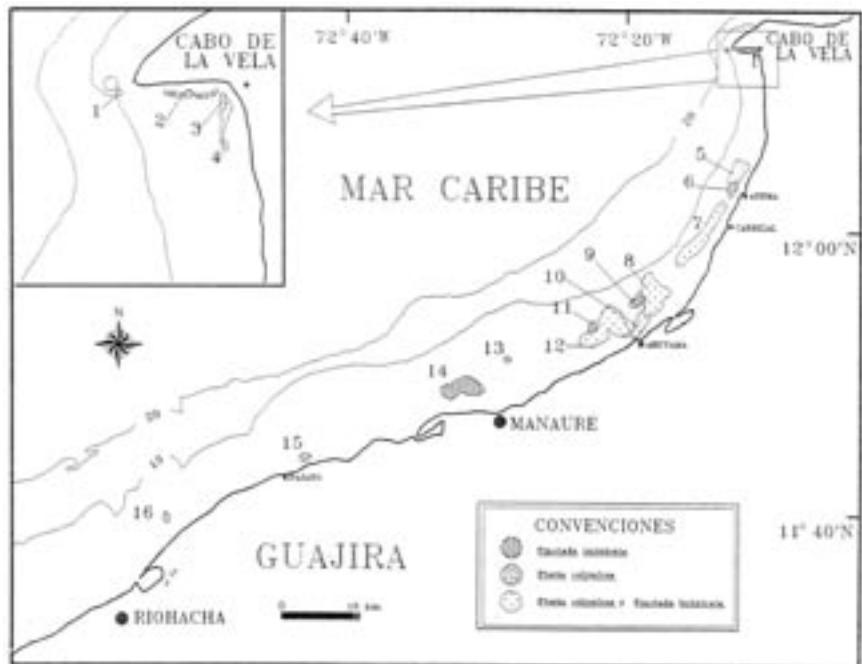


Figure 18.—Locations of oyster beds in the shallow zone off the coast of Guajira, Colombia, in 1994; depths are in meters; numbers to beds refer to specific names of beds (not given) (from Borrero et al., 1996).

California³, and 3) the market for natural pearls became weaker because imitation pearls were being manufactured in Venice and elsewhere in Europe, and diamonds had become a popular gem (Kunz and Stevenson, 1908; Galtsoff, 1950b).

1600's to Mid-1800's

Galtsoff (1950b) believed that after 1600 the pearl oyster fishery continued on a gradually diminishing scale. By the 1620's, only 130 black divers were left in the Margarita Island area, and by 1683, harvesting had practically ceased. Besides a scarcity of oysters, sea-going pirates made frequent raids to take any valuable products from Margarita Island, Cubagua Island, and Coche Island, making it difficult to continue pearling as a worthwhile industry.

The Spanish colonists eventually became aware of the principle of conserving natural resources. Mosk (1934, quoted by Galtsoff, 1950a) found one report written in 1613 that said it was fruitless to take pearl oysters from the beds near Margarita Island because they were full of small oysters and to take them would be a detriment to the interests of the pearl fishery and the Royal Treasury. Otherwise, little information exists about the pearl oyster industry in Venezuela during the 1600's, all of the 1700's, and the first half of the 1800's, perhaps because it was insubstantial. On a trip to Venezuela in the early 1800's, Humboldt (1814–29, quoted by Galtsoff, 1950b) said the pearl oysters had greatly multiplied after 2 centuries (1600's and 1700's) with little harvesting.

1845 to 1948

The pearl oyster fishery started up again in about 1845, and for several years thereafter an average of 45 kg of pearls/yr were landed. The oysters were harvested by divers and with dredges towed by sail boats. In 1853, the gov-

³ These grounds, exploited after Balboa's discovery of the Pacific Ocean when he crossed the Isthmus of Panama in 1513, were producing well and were lucrative, especially after effective transportation of the pearls from the Pacific Coast to Europe was developed.



Figure 19.—Fleet of sail boats dredging oysters from Las Cabeceras bed, 1945 (from Cervigon, 1998).

ernment prohibited the use of dredges, and, by 1857, the landings were only slightly above 11 kg. Between 1857 and 1895, there were small intermittent pearl landings. An ounce (28.35 g = 192 carats) of good quality pearls there sold for US\$29–98 and inferior pearls for US\$16–20 (Quiévreux, 1900; Kunz and Stevenson, 1908).

In the 1890's, increased market prices for pearls stimulated a regrowth of the Venezuelan pearl oyster industry. This coincided with a period of prosperity in Europe and the United States. In 1895, the use of hardhat gear was tried for the first time near Margarita Island, but the divers and dredgers opposed its use. In 1899, Porlamar, the principal city of Margarita Island, had 7 licensed pearl buyers (Galtsoff, 1950b).

In the early 1900's, the Venezuelan government granted concessions to individuals and companies for harvesting pearls in defined areas and for limited periods, and it exacted a 10% royalty on the value of their pearl sales. It also prohibited oyster harvesting in some years when they were scarce. The total annual value of the pearls harvested was about US\$350,000 (Cervigon, 1998).

Large-scale Hardhat Diving

Beginning in 1912, the use of hardhat gear to harvest pearl oysters began on a large scale while harvesting by divers and dredgers continued in Venezuela. The hardhat divers worked at depths not exceeding about 16 m (Galtsoff, 1950b; Gaspar, 1999).

Cervigon (1998) provided some details about the pearl oyster fishery between 1918 and 1930. In 1918, it included about 400 boats, all using sail. There were 145 hardhat divers, about 150 dredging boats, and 100 divers. They sailed from ports on Margarita Island and from the port of Mariquada on the mainland. Most boats were about 7–7.5 m long, but some ranged to 9 m long, and they were under contract or under a manager. Individual managers had as many as 15–20 boats or 3–5 divers harvesting pearl oysters for them. The hardhat divers were controlled by 25 separate managers. Harvests were conducted from Mondays through Saturdays, and one could see the sails from the south shores of Margarita Island (Fig. 19). During the June to December off-season, pearl oyster harvesters

earned a living by finfishing and working ashore.

Cervigon (1998) said each boat sailed back to its port and its pearl oyster sacks were transferred to floating rafts that were anchored about 50 m from shore. Each raft had about six men and women who shucked the oysters with ordinary knives. Shucking often was done the day after the oysters were harvested, because they were easier to open and find the pearls. When the shuckers opened each oyster, they lifted the edge of the meat with their knife and looked for pearls located between it and the mantle. Another method was to spread out the meats and let them rot and dry before looking through them. It took them about 2 hr to shuck a day's pearl oyster harvest. An inspector on each raft made sure the shuckers did not steal any pearls.

Most pearls were sold in Porlamar. Through the years, the industry used various terminologies for the grades of pearls. In the mid-1900's, the pearls were grouped into four grades: 1) *de vistas* (symmetrical, good color and luster, and weighing more than 2 g and at least 7 mm in diameter), 2) *redondas* (similar to the *de vista*, but smaller and almost round),

3) barroques (irregularly shaped), and 4) mostacilla (poor quality and small). In addition to these grades there were seed pearls, 1–2 mm in diameter (Cervigon, 1998). Between 1918 and 1924, pearls sold in Venezuela for between US\$3.85–5.80/carat, depending on their shape and brilliance (Galtsoff, 1950b). In 1923, pearl production in Venezuela had a value of US\$500,000. In 1932, the pearl production was 437 kg (2,185,505 carats), but it declined afterward, except for 1943 when pearl production was 1,000 kg (4,998,257 carats) (Table 2).

Over the years, scarcities of pearl oysters on the beds limited harvests, but when the beds were left undisturbed the oysters became more abundant as a result of oyster larval settlement and growth. During the 1900's, government authorities used this knowledge to conserve the pearl oysters by closing the fishery for a season or two and then reopening it for a season or more. In 1936, the fishery was closed but, in 1937, it was active (Cervigon, 1998). (Note: the average landings over a period of years may have been about the same had the beds not been closed for a season or two).

Pearl Industry in Colombia

In the first few decades of the 1900's, pearl oysters were harvested off the coast of Guajira, Colombia. Most harvesting was done in the offshore area between the towns of Pajaro and Cabo de la Vela. Men harvested the oysters by diving without masks or flippers, little different from 400 years before. Four or five divers in each small boat went out to the beds, harvested, and carried the oysters back to shore, where women shucked them and removed the pearls. Local merchants purchased the pearls and sold them in Europe, mainly in France and Germany. Pearl oyster harvests in Colombia ended in about 1940 (Borrero et al., 1996).

1940's

Harvesting Regulations

Galtsoff (1950b) said the harvesting of pearl oysters was regulated by the "Ley de Pesca de Perlas" established in 1944. It permitted harvesting for 4 months, between January 1 and April 30. Each

year, a resolution (in a compilation of laws) of the Margarita Island Ministry of Agriculture announced the opening of the season 60 days before the opening date (Article 5, Chapter II, Ley de Pesca de Perlas). The harvesting in any area or part of it could be ordered closed by this Ministry. The action would be promulgated upon the information the Ministry received from the fisheries administrator regarding oyster abundances on the beds. The Ministry could also limit the number of diving boats operating, and it could temporarily prohibit their use (Article 8, Chapter II). It also had the right to limit the number of dredges used on each boat, but it was required by law to reconcile the interests of the various classes of applicants (Article 9, Chapter II). The law (Article 10, Chapter II) required that undersized oysters (under about 5 cm long), commonly called "conchas en flor" ("shells in flower"), be immediately returned to the bottom.

Some earlier laws relating to crew sizes remained in effect:

- Dredgers: No more than the master and six fishermen were allowed on a boat.
- Hardhat divers: Only one hardhat diver and six helpers were allowed on a boat.
- Divers: Only the master and six fishermen (inclusive of the free divers) were allowed on a boat.

Harvesting and Shucking

Galtsoff (1950b) and Cervigon (1998) described the pearl oyster fishery and the selling of pearls in the mid to late 1940's. The same three methods used for harvesting oysters earlier in the 1900's were employed. The number of boats or units harvesting can be estimated from the number of licenses issued: 412 for dredging, 28 for hardhat diving, and 1 for diving, but the numbers of boats harvesting each day were less than the number of licenses issued. The licenses were issued for each month and the number issued varied slightly by month. The 1945 season was the first that was limited to 4 months. Out of that 120-day period, the boats had about 60 days of effective oyster harvesting. The shorter

Table 2.—Pearl oyster production in Venezuela from 1919 to 1947 (Galtsoff, 1950b).

Year	Carats	Values
1919		82,875 ¹
1921–22		60,410 ¹
1932	2,185,505	336,440
1934	517,172	200,000
1937	418,207	157,202
1940	1,369,874	287,225
1943	4,998,257	773,840
1945	1,400,214	315,000
1946	1,281,899	500,000 ¹
1947	1,784,857	1,250,000

¹ According to Lopez (1950), the total yield of pearls during the 19-year period from 1921 to 1940 was 7,069,630 carats, valued at about US\$3,675,000. Values are in US\$.

season in 1945 allowed the oysters to become more abundant, so government officials allowed harvesting for 3 consecutive years, 1945, 1946, and 1947. In those years, 3,000 people were directly engaged in the pearl fishery. In 1947, the landings of oysters and pearls taken by each method were 330,034 sacks (877,427 carats of pearls) by dredging, 29,003 sacks (155,000 carats of pearls) by hardhat divers, and 100 sacks (300 carats of pearls) by divers (note: landings data reported by Galtsoff, 1950b and Cervigon, 1998 for the same years differed). The pearl oyster harvest was about 11,000 t of whole oysters.

Galtsoff (1950b) said the pearl oysters had become scarcer during 1947 and the administrators closed the beds in 1948. He thought the administrative control was beneficial, because it protected the oyster resource from excessive harvesting, but he recognized that the fishermen, shuckers, and their families, and the markets suffered, though, from the irregularity and uncertainty in their industry. But were the bed closings really beneficial when the fishermen left the undersized oysters on the beds anyway? Though it is difficult to know without controls, the average landings over time might have been at least as high had the seasons never been closed.

Galtsoff (1950b) and Cervigon (1998) said a complex scheme of dividing the proceeds of the fishermen's catch was governed by local tradition and custom. For a dredging boat: 1.5 shares went to the owner of the boat, 4 shares went to the owner of the dredges (2 for each dredge), 1.5 shares went to the master

who was responsible for selecting and finding the oyster beds, 1 share to each crewman, and 1 share to each of the two shuckers. But the division of proceeds was different in the case of a diving boat, 50% of the money from the sale of the pearls went to the person who owned or outfitted the boat; of this amount, he paid half of the license fee and gave 33% of the balance to the diver. The rest was his. The remaining 50% was divided among the crew. First, the cost of any food and half of the license fee was deducted; the balance then was divided into 14 shares, of which 6 shares were paid to the diver, and 8 shares were equally divided among the remaining crew.

Galtsoff (1950b) observed that most hardhat divers were middle aged. Younger men were reluctant to become professional divers. He believed if the trend continued the scarcity of experienced divers might lead to the complete abandonment of hardhat diving. His prediction was accurate because harvesting by hardhat diving did decline and it ended about 15 years later.

After harvesting, the pearl oysters were taken ashore to be shucked. Most were taken to Isla Caribe, where large shell heaps, some nearly 6 m high, laid about where shuckers had left them after many years of pearl oystering. The heaps had deep holes or trenches that had been dug by women and children who searched for pearls among the discarded shells. The shucking crews lived in small cabins on the shore during the oyster seasons (Fig. 20) (Galtsoff, 1950b). They removed most of the pearls as they opened them, but they also cooked the oyster meats in drums holding about 200 L of water to obtain any pearls that they may have missed. They stirred the boiling mixtures with paddles, and any pearls remaining in the meats were collected later from the bottom of the drums (Mendez-Arocha, 1963). The shuckers saved some oyster meats for preparing simple meals for themselves, but discarded most with the shells they dropped to the ground in front of their feet. As the shells and meats accumulated, hundreds of flies swarmed around each pile. The contrast between the beauty of the pearls and the



Figure 20.—Shucking pearl oysters on Cubagua Island, probably 1940's (from Cervigon, 1998).

miserable working conditions of the people who produced them was striking. The average yield per sack of oysters was 4.5 carats (1–2 marketable pearls) (Galtsoff, 1950b).

Selling Pearls

The fishermen sold their pearls to licensed buyers in Porlamar or directly to tourists and visitors on Margarita Island (Fig. 21). At the beginning of the oyster harvesting seasons, there were nine operating buyers who opened their offices to appraise, sort, and purchase pearls. Fishermen brought the pearls to buyers' offices in a handkerchief or piece of cloth, and the pearls were spread on a green woolen cloth that covered a table. The buyer picked out and set aside the best pearls, and then, using a small, shallow silver scoop, he put the remaining pearls into a set of copper cups, 7–10 cm in diameter, with perforated discs containing holes that ranged from 1 to 6.5 mm in diameter (Fig. 22). The largest holes retained pearls of more than 8 grains (about 2.5 carats). The buyer weighed the groups of different sizes of pearls separately and quoted his prices for them (Fig. 23). He then poured each size grouping of pearls into small cotton

bags, or wrapped them in brown paper and stored them in boxes (Galtsoff, 1950b).

In April 1948, the buyers were paying an estimated 2.5 bolivars (US\$0.35)/carat for fairly good pearls. If the fishermen thought the price was too low, they visited other buyers for a better price. Whenever the price offered by all the buyers was unacceptable, the fishermen turned their pearls over to the fisheries administrator's office in Porlamar for official appraisal and disposal of the pearls through the Government Bank. The bank paid the value determined by official appraisers minus a 10% commission. The pearls became government property and the bank sold them when market prices were higher. In 1947, the bank purchased US\$250,000 worth of pearls (Galtsoff, 1950b).

Most pearls were exported to Europe, India, and China. Pink pearls, common in Venezuela, were highly desired in Europe, while India and China imported large quantities of tiny seed pearls. In India, many seed pearls were used to "treat" children's eyes. One or two seed pearls were placed under babies' eyelids for several minutes in the belief this made their eyes darker and shiny. Adult Indians



Figure 21.—Her Majesty Queen Sophia of Spain (R) and Flor Avila-Vivas (L), admiring collection of pearls in Ms. Avila-Vivas' museum shop, Porlamar, Margarita Island, November 1997.

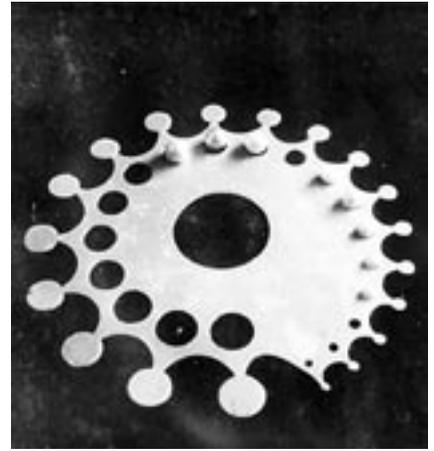


Figure 22.—A grader for sorting pearls into various size groupings.



Figure 23.—A buyer weighing some pearls in Porlamar, Margarita Island.

and Chinese ate seed pearls, whole and ground into powder, because of the belief they benefitted their health (Landman et al., 2001). Relatively small numbers of pearls and of only the highest quality were distributed in the United States through wholesalers in New York City; they wanted white pearls with high luster (Galtsoff, 1950b).

Venezuelan Pearl Oyster Industry, 1948–2002

During the 54 years between Galtsoff's stay in 1948 and 2002, the pearl oyster industry in Venezuela changed substantially. The pearl harvests nearly ended. This came about during the 1950's and 1960's, when a massive production of

saltwater cultured pearls, mainly from Japan, inundated the jewelry markets of the world. The cultured pearls were prettier, larger, and more nearly round than most natural pearls, and they sold at much lower prices than natural pearls.

By 1940, the Japanese culturists were producing about 10 million pearls annually (McClintock, 1994). In later years,

cultured pearls were produced by other countries bordering the western Pacific Ocean and some Pacific islands as well. As these pearls gained acceptance, the prices of natural pearls crashed and their industries in Venezuela and other countries became tiny remnants of what they had been (Ward, 1998). In addition, since the late 1960's, China has been producing substantial quantities of freshwater cultured pearls for jewelry markets, and they are much cheaper than the Asian saltwater cultured pearls (Ward, 1985). Freshwater pearl culture also has had limited success in the United States (Sitwell, 1985; Latendresse⁴).

After 1950, the price of Venezuelan pearls did not exceed US\$1.20/carat, and, in 1961, the price was US\$0.52/carat for the best quality pearls and US\$0.33/carat for the poorer quality pearls. Such prices contrasted sharply with those during the years 1918 to 1924 when they ranged from US\$3.85 to 5.80/carat. Venezuelan pearl production fell from 360 kg in 1947 (Galtsoff, 1950b) to roughly 2 kg in 1969 (Cervigon, 1998).

Fishery Changes

The changes in the Venezuelan pearl oyster fishery featured:

- 1) the sale of nearly all oyster meats to people for food, to provide nearly the entire income for the fishery,
- 2) large declines in the numbers of oyster beds, boats, and fishermen and other industry people,
- 3) abandonment of diving, including hardhat diving, leaving dredging as the means of harvesting oysters,
- 4) a switch from sails to outboard motors to propel dredging boats, and
- 5) a shortening of the oyster season.

The remnant harvesters and shuckers were able to keep the industry going, although on a small scale, by selling the

meats beginning in about 1960. Soon afterward, government officials mandated that whole oysters had to be cooked when they were brought in from the beds. This was a sanitary measure as it was believed bacterial counts in live oysters would rise to unsafe levels in the warm air before people ate them. Cooking pearl oysters does not affect the luster of the pearls in them.

Some of the 76 beds, other than the Las Cabeceras and Los Frailes beds, Galtsoff (1950b) listed as surveyed in 1943 may still have some oysters in 2002, but they are too scarce to support commercial harvests. Perhaps the harvesting switch to dredging was a major cause in the decline in oyster abundances. Can abundances of pearl oysters that lie on a substrate of sand be sustained when fishermen dredge intensely for the market-sized oysters each year, or, were unidentified environmental factors part of the cause? These are questions for further research.

Fewer people now are involved in the fishery. The number fell from the 3,000 in 1947 to about 300 people (fishermen, shuckers, and vendors) in 2002.

In recent years, the government has restricted pearl oyster harvesting to January and February as a conservation measure, thus shortening the season from 4 to 2 months. It issues a license to each fisherman-owner of a dredging boat for US\$35 that allows him and his crew to harvest pearl oysters for a season. The license is issued to 30–45 boats. Each is limited to a harvest of no more than 10 sacks or 600 kg of oysters (about 10 bushels)/day.

During the 2000 season, estimated landings for all the dredge boats were roughly 500 t of live pearl oysters (about 20,000 bushels). They represented a tiny component of the landings of marine products in Nueva Esparta, only about 0.2% of the total. This contrasts with data in 1945, 1946, and 1947, when Galtsoff (1950b) said the pearl landings comprised from 6.8 to 14.1% of the landings.

Status of Pearl Oyster Beds

The large Las Cabeceras bed and the small Los Frailes beds off northeastern Margarita Island have oyster abundances large enough for commercial harvesting.

The Las Cabeceras bed, which begins 200–300 m east of Cubagua Island, now is about 4 km long, 2 km across, and it is under about 8 m of water. The Los Frailes beds lie just west of the Los Frailes Islands under about 5.5 m of water.

Las Cabeceras Bed

The oysters and other biota on the Las Cabeceras Bed are concentrated in dark patches, that stand out from the yellow sand between them when viewed through the clear water from a drifting boat. The patches are 18–25 m across and about half of the sand bottom is covered by the patches. The oysters are relatively young: Few are more than 18 months old because nearly all oysters above 5 cm long are harvested each season.

During recent harvest seasons, from 30 to 40 boats have been dredging oysters on the Las Cabeceras bed every day during calm periods. The boats are driven by outboard motors (40–75 hp) and are mostly 6–7 m long, while the largest are 8–9.3 m long. Each day, at about 3–4 a.m., 20–30 boats leave for the bed from 3 ports on Margarita Island and about 10 come from the mainland; the latter harvest illegally as by law they are restricted to beds near the Venezuelan mainland, but they find few oysters there. The Margarita Island boats reach the bed in about 30 min and each crew tosses out their one dredge to begin harvesting. The dredges do not have the wooden sticks on their bottoms to protect their meshes that Galtsoff (1950b) had described because this bottom is entirely sand. The fishermen probably dredge up and return nearly all the biota and shells lying on the bed at least once during every harvesting season.

Manzanillo–Los Frailes Area

A tiny industry harvests and processes mussels and pearl oysters in the Manzanillo–Los Frailes area. During the oyster season, on every day with light to moderate winds, two boats from Manzanillo motor about 12 km to the beds off the Los Frailes islands. Each boat has about five men, all divers, who take turns harvesting mussels and oysters using hookah outfits (equipment that includes an air compressor on the boat and a long air hose to the face mask worn by the diver). Consider-

⁴ Latendresse, G. Freshwater pearl culture in the United States. A talk presented at 92nd annual meeting of the National Shellfisheries Association. New Orleans, LA. April 13–17, 2003.



Figure 24.—Removing a sack of pearl oysters from tub of boiling water in which oysters were cooked for 20 min, Punta de Piedra, Margarita Island, February 2002.



Figure 25.—Dumping pearl oysters onto shucking table after they were cooked, Punta de Piedra, Margarita Island, February 2002.

able finfishing takes place in the area, so the harvesting is done by diving because it is believed dredging will degrade the fish habitat. The two boats harvest a total of 30 sacks of mostly mussels, but also some pearl oysters. They are sold to shucking groups in Manzanillo.

Processing and Marketing Oysters

Most oysters harvested from the Las Cabeceras bed are processed on the shores of Punta de Piedra, Margarita Island. Each boat has a location on the shore where its harvested oysters are cooked and shucked. The boats return to shore with their oysters at 7–10 a.m. The fishermen in each boat carry the sacks of oysters ashore and set them beside 1–2 tubs of boiling water heated by gas torches. They then wade in the water and anchor their boats perpendicularly to shore. Two members of each crew, using a 2 m stick, then lift one of the sacks into a tub and leave the oysters cooking for 20 min (Fig. 24). Using the stick, they then lift it from the tub and empty the steaming oysters onto a table (Fig. 25) surrounded by a crew of sitting shuckers (Fig. 26), and then continue handling the remaining oysters in the same manner. The shuckers typically are the wives and children of the fishermen. They open the oysters with



Figure 26.—Family group shucking pearl oysters in the shade, February 2002. This family group expressed good feelings about their continuing the long tradition (>500 years) of shucking pearl oysters.

kitchen knives and toss their meats into a common bowl in the center of the table. Every few minutes, the shuckers toss an oyster or mussel meat into their mouths to eat. A group of 8 shuckers opens a sack of oysters in 10 min.

In Manzanillo, the mussels and oysters are also cooked in tubs, shucked, and

the meats are sold. Any excess of live mussels and oysters is stored in baskets subtidally along the Manzanillo shore.

About 80% of the oyster meats on Margarita Island now are eaten in soups and stews, and some are creamed. The women shuckers take some meat home to eat, and the men take the bulk of it to



Figure 27.—A stand and manager with display of Atlantic pearl-oysters, *Pinctata imbricata*, and mangrove oysters, *Crassostrea rhizophorae*, on a beach, Porlamar, Margarita Island, February 2002. Both sold raw on the half-shell for \$1.30/dozen.



Figure 28.— Serving plate containing raw pearl oysters on the half-shell on a beach, Porlamar, Margarita Island, February 2002.

sell. Buyers pay the fishermen US\$2.00/kg for the meats, and sell them for US\$2.67/kg to local food markets, restaurants, and hotels. The meats are also peddled along the streets, where vendors add chile and onion and carry them warmed in a pan on their heads. Customers purchase them in plastic bags to eat as a snack. On swimming beaches, different vendors sell some pearl oysters along with mangrove oysters, *Crassostrea rhizophorae*, both raw on the half-shell for \$1.30/dozen, on paper plates to small family parties or groups of friends (Fig. 27, 28). People eat them and then toss the empty shells and plates into 50-gallon waste barrels. Fishermen harvest the mangrove oysters in La Restigna Lagoon on Margarita Island. The meats of raw and cooked pearl oysters are far more “chewy” and have a poorer flavor than mangrove oysters that are somewhat sweet. The remaining meats are ferried to the mainland where they bring about US\$4.00/kg.

Selling Pearls and Shells

As they open the oysters, shuckers find a small number of marketable pearls and

save them in their pockets. The pearls are sort of a prize or bonus for the shuckers, who sell their small collections whenever they need some extra money. Each makes US\$80–100/year selling pearls to dealers, such as Flor Avila-Vivas⁵, the largest pearl wholesaler in Porlamar, to jewelry shops, to tourists on beaches, and some at their doors. In 2001, Ms. Avila-Vivas bought 2 kg of pearls from 25 to 30 families. They bring them to her in vials (about 150 pearls/vial), small match boxes, and little bags. She purchases the pearls by weight. A vial of pearls typically brings fishermen US\$6.67. She has little sale for tiny seed pearls (Fig. 29), but the shuckers insist she take them. They also bring her some blister pearls; such pearls are attached to the inside surfaces of oyster shells (Fig. 30). Ms. Avila-Vivas’ shop also cuts some shells that are especially shiny into round or oval shapes and sells them as pins and necklaces (Fig. 31). Shuckers bring her fewer pearls each year as the oyster stocks are believed to be dwindling.⁶

⁵ Mention of trade names or commercial firms does not imply an endorsement by the National Marine Fisheries Service, NOAA.

Recommendation for Oyster Bed Management

Galtsoff (1950b) recognized that oyster abundance would increase if shells were spread on the harvesting beds, and he described and photographed the large shell piles on Isla Caribe that were available for this. But he believed more biological information was needed to determine the periods of intense setting of oyster larvae and the locations where the larvae set most densely before this was done. He recommended studying the effects of oyster predators and possible parasites and diseases. The length of Galtsoff’s stay in Venezuela was too short for him to implement any of his recommendations. Some studies relating to biology were carried out later, though these may have been done without knowledge of Galtsoff’s recommendations. For example, the timing of oyster spawning and setting of larvae are now known (León et al., 1987), but shelling the beds was scarcely ever done.

⁶ Avila-Vivas, Flor. Porlamar, Venezuela. Personal commun., 2001.



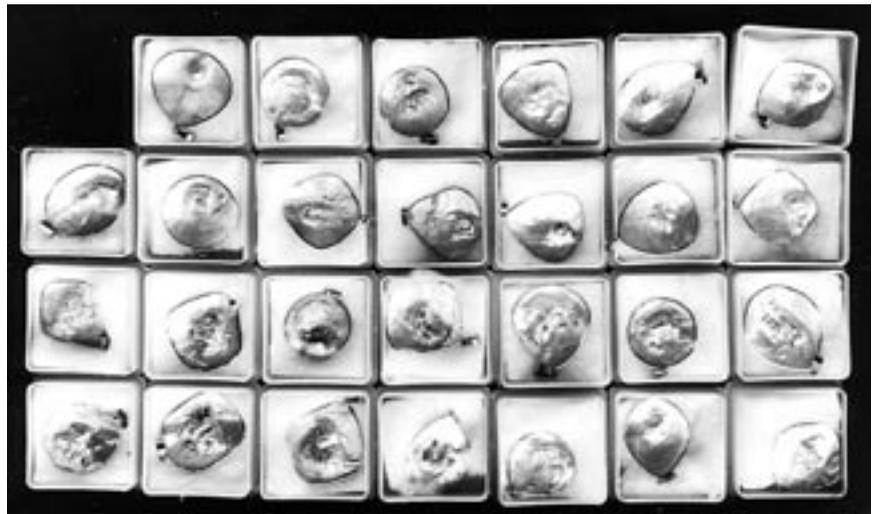
Figure 29.—Nearly every market-sized pearl oyster has tiny seed pearls, February 2002.



Figure 30.—Blister pearls attached to the shells of pearl oysters.

Figure 31.—Jewelry pins made from the shells (inner surfaces) of pearl oysters, displayed in a Porlamar museum, Margarita Island.

During the January–February oyster harvesting seasons, the oyster shuckers continue to discard the shells onshore. A program could be developed to store the shells and then spread them on the beds during the June–November period when the oyster larvae settle. To conserve or enhance the dwindling oyster stocks, perhaps some old shell piles have hard shells that could be used, but the oyster shell piles that Galtsoff (1950b) described in 1948 on Isla Caribe as being 6 m high may have few suitable shells. They have since been partially broken down by the sun and dissolved by rains and now are about 1.5 m high. During the summer months, the fishermen would not be able to transport and spread the shells as it would require too much time and expense when they are occupied with other types of work. This would probably have to be a government-sponsored project. Government officials could try to find the means to



have the fishermen store the shells and then have them barged to the beds and spread them.

In the Introduction, we said that by the end of the 1500's, Venezuelan pearl oyster stocks and production had declined sharply, and also noted that throughout the entire extent of this pearl fishery the shuckers have discarded the oyster shells. Had the harvesters con-

sistently spread all the shells back on the beds instead, we believe the oyster stocks would not have declined as much in the 1500's, and they would have been sustained better afterward. It could be said that overharvesting the oysters was not the entire problem, and that the oysters declined also because the fishermen reduced their habitat: the oyster shells on which the oyster larvae attach.

Acknowledgments

We thank Luis Cornieles for effective guiding and translating; Leon Ramon Hernandez Salazar for describing how hard-hat divers harvested pearl oysters; Flor Avila-Vivas of Porlamar for describing how a pearl buyer functions; Fernando Cervigon for granting us permission to use illustrations from his book, *Las Perlas en la Historia de Venezuela*; Victor G. Burrell, Jr., Dexter S. Haven, and an anonymous reviewer for constructive comments on an earlier draft of this paper; and Thomas Finneran for making the maps. W. L. Hobart suggested we write this paper.

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